Internal and permeability structure of Iida-Matsukawa fault

Yasuhiko Saito[1], Kazuo Mizoguchi[2], Wataru Tanikawa[3], Toshihiko Shimamoto[4]

[1] Dept. of Geol. and Mineral., Kyoto Univ., [2] Earth and Planetary Sci., Kyoto Univ, [3] Geology and Mineralogy,Kyoto Univ, [4] Dept. of Geol. & Mineral., Graduate School of Science, Kyoto Univ.

Permeability structures of fracture zones are important in discussing fluid flow in the crust, fault rheology, mechanisms of earthquakes or seals of hydrocarbons. Our group in Kyoto University has examined permeability structures of various faults for the last three years. The variety of natural faults is such that more investigation is required. Lin (1996) suggested that fault gouges along the main fault were injected to the surrounding rocks by fluidization. Fluidization of fault gouge is important in discussing mechanisms of earthquakes because it causes weakening of fault. Whether fluidization occurs or not depends on the increase in pore pressure and the escape rate of pore fluid. The most important parameter that controls the escape rate is the permeability of fault. Hence, we described the internal structure of fault rocks in Iida-Matsukawa Fault and measured its permeability in order to reconsider the fluidization.

The fault zone at an outcrop in Suzugataira area, in the west of Iida City, Nagano Prefecture, is about 10 meters in thickness. Fault gouge occurring along the fault plane is 5-20 mm in thickness. The fault zone on the northern side consists of grayish cataclasite (10-20 cm) and whitish foliated cataclasite (about 1 m). The fault zone on the southern side consists of foliated cataclasite (about 1 m), undeformed fine granite and fractured host rock. Planar structures of foliated cataclasite are characterized by elongated biotite. The foliated cataclasite in both side are very similar in microstructures, but are different in hardness. Foliated cataclasite on the northern side is very hard, while that on the southern side is weak.

Samples for the permeability measurements are picked around Suzugataira outcrop. We used high-temperature high-pressure deformation and fluid flow gas apparatus at Kyoto University, and the techniques used to measure permeability are the oscillating pore pressure method and the constant flow rate method. Nitrogen was used as pore and confining fluid. Results are as follows - fault gouge along the fault plane : 10^(-15) m^2, cataclasite and foliated cataclasite on the northern side : 10^(-16)-10^(-17) m^2, foliated cataclasite on the southern side : 10^(-14)-10^(-15) m^2, fractured host rock : 10^(-16) m^2, and host rock (granite): 10^(-17) m^2.

Permeability of fault zone is higher than that of the host granite nearby, which suggests that fault acts as conducts of fluids in crusts. Permeability of rocks on the northern side is lower by 2-3 orders of magnitude than that on the southern side. Permeability of the southern foliated cataclasite is 10^(-14)-10^(-15) m^2, which suggests that fault gouge cannot inject because pore fluid diffuses from the fault plane easily.